

# STEADY-STATE MEASUREMENT OF THERMAL CONDUCTIVITY OF CERAMICS AND CERAMIC COATINGS

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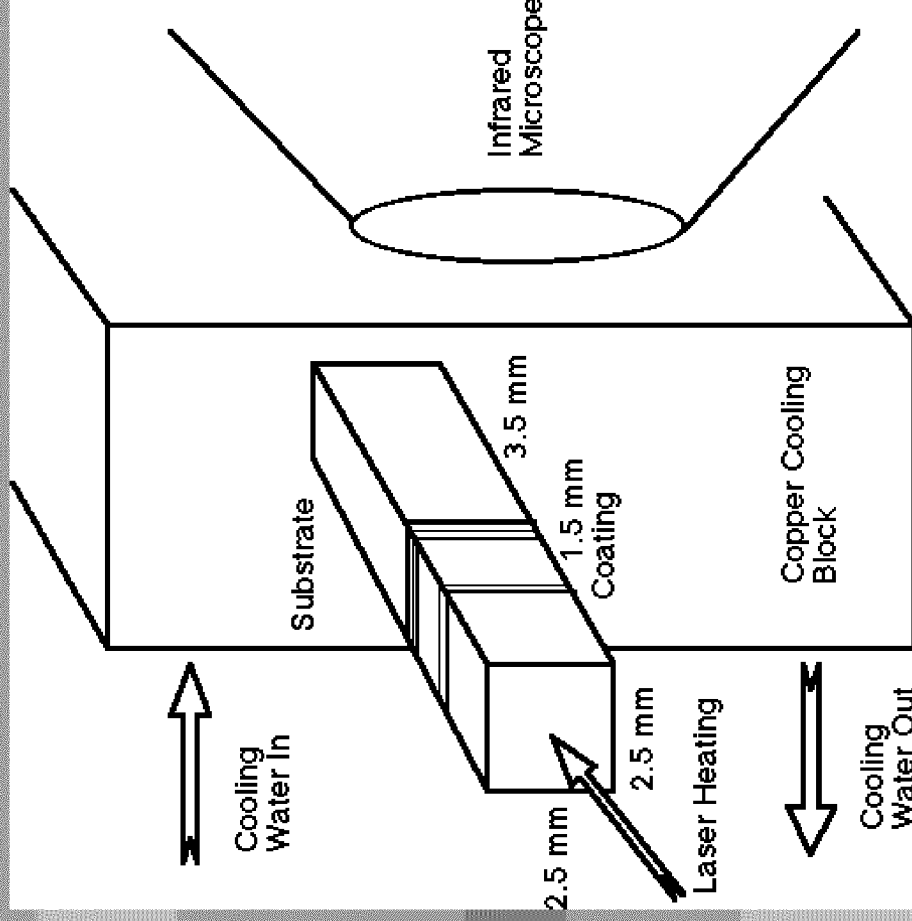
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# Discussion Points

- Steady-State Measurement Method
- Validation
- EB-PVD  $\rightarrow$  EB-DVD
- Future Direction (SPM)



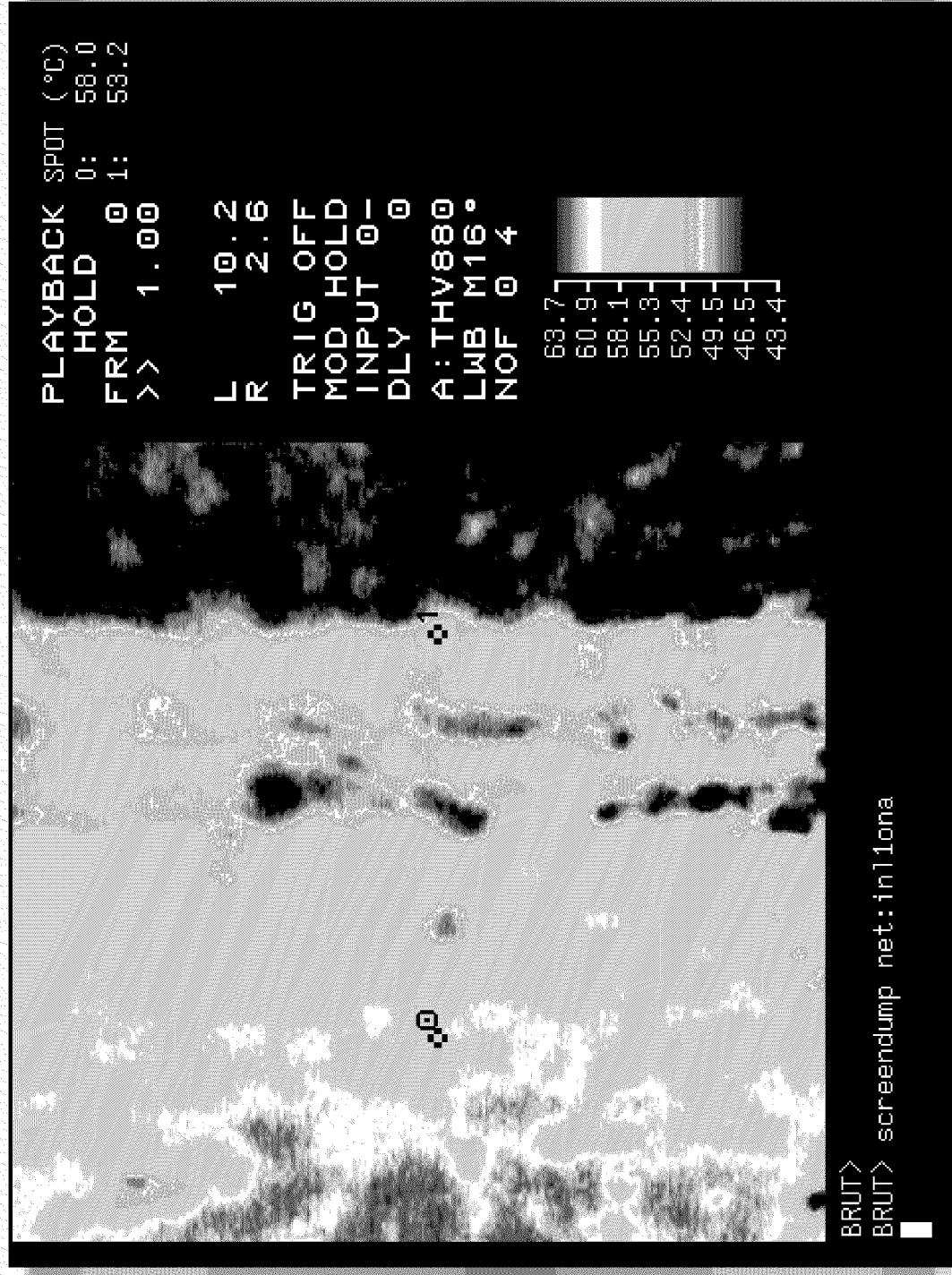
# Measurement using Infrared Microscopy



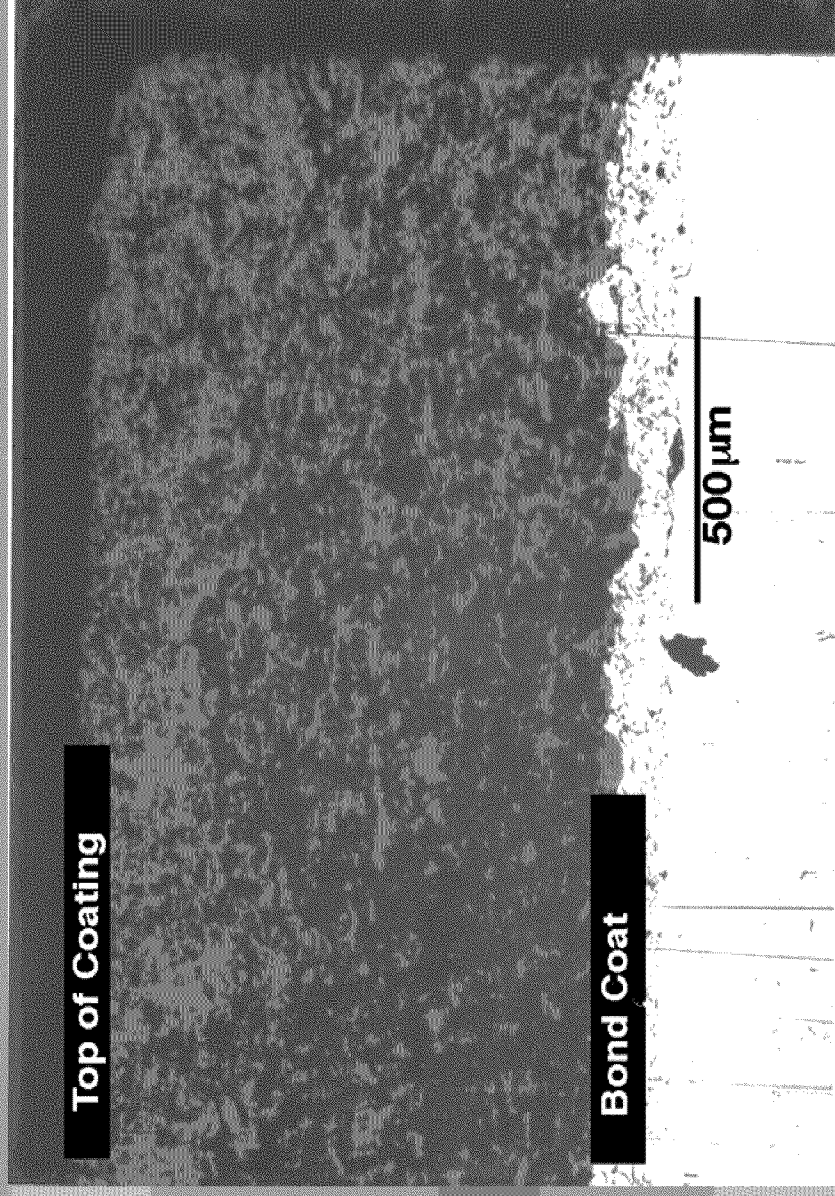
- 1.6 x 1.6 mm field-of-view
- 8 to 12  $\mu\text{m}$  detection
- 10  $\mu\text{m}$  spatial resolution
- Room temperature to 250  $^{\circ}\text{C}$
- Steady-state
- Laser or Joule heating



# Infrared Micrograph of an Alumina-Nickel, 4-layer Functionally Graded Coating on a Nickel Substrate

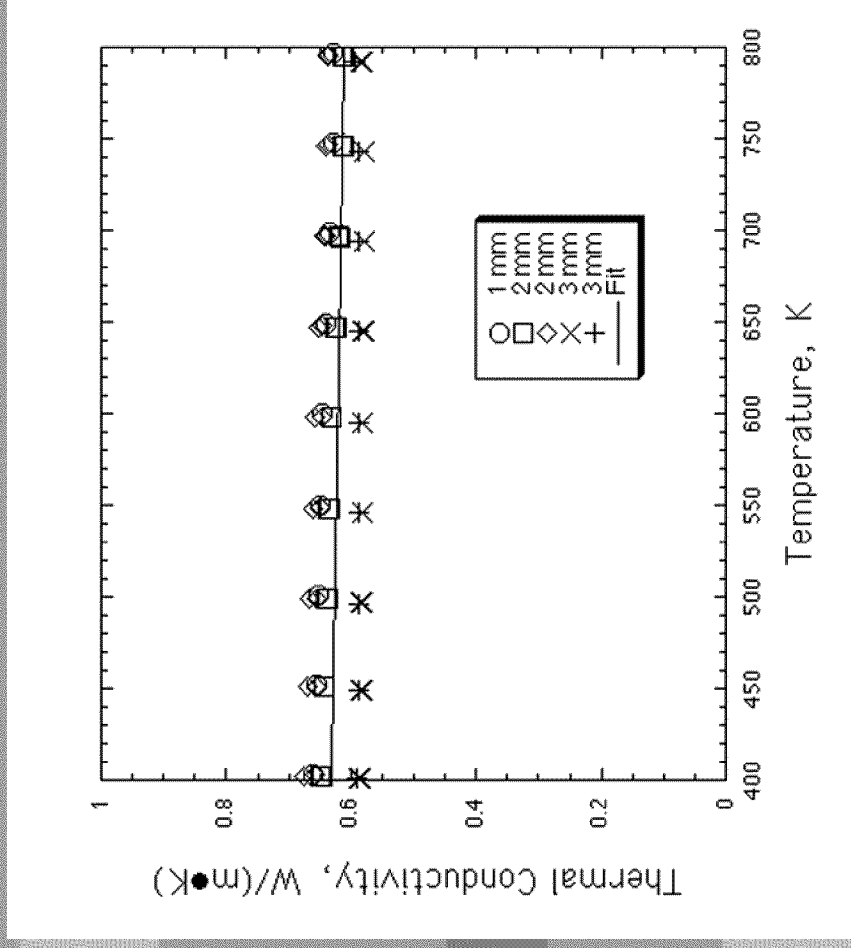


Plasma-Sprayed 1.0 mm thick 8% Yttria-Stabilized  
Zirconia Coating with 0.1 mm thick NiCrAlY Bond  
Coat on 410 Stainless Steel





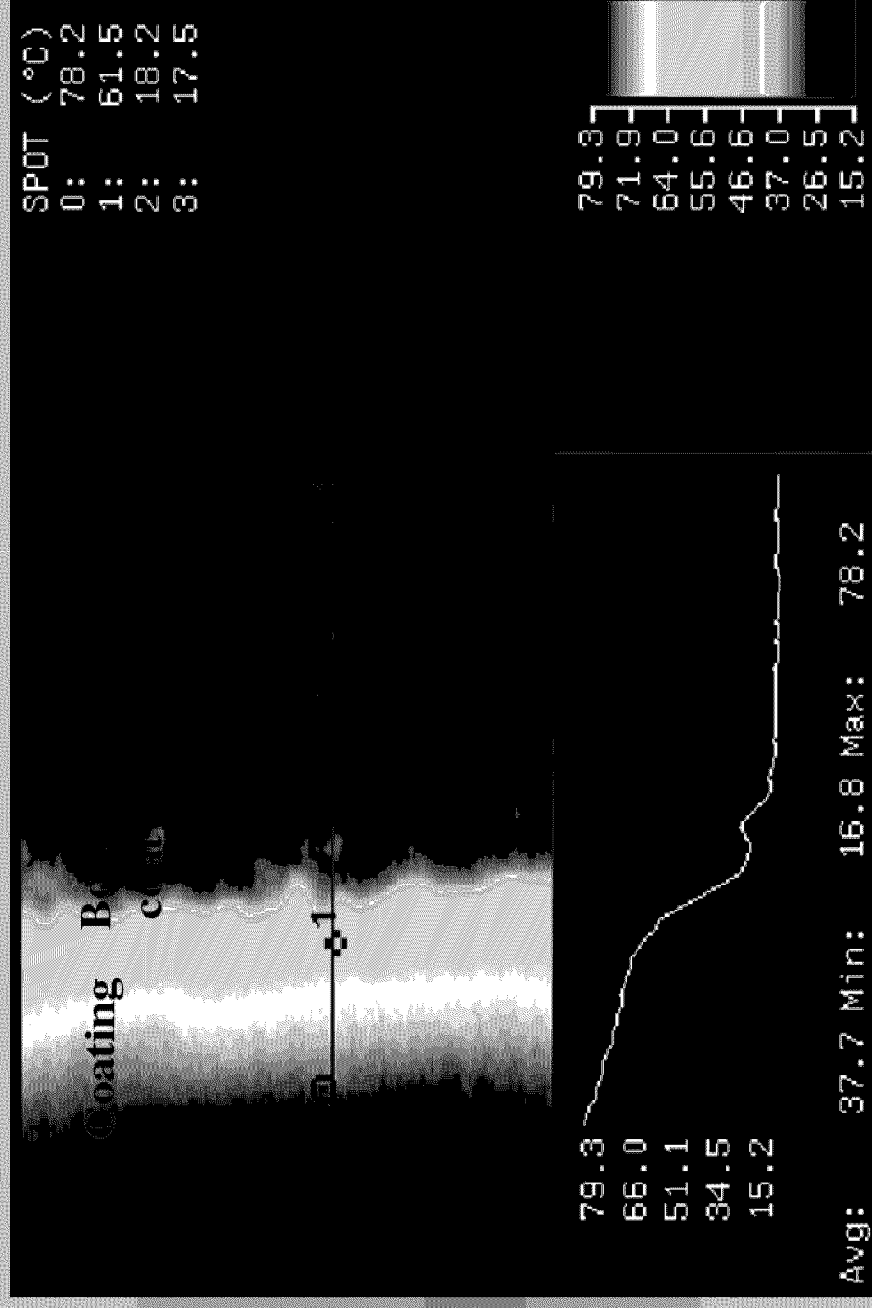
# Results for an 8% Ytria-Stabilized-Zirconia Coating on 410 Stainless Steel





# Infrared Microscope Image of a Plasma Sprayed 8% Yttria-Stabilized Zirconia Coating, 1.0 mm thick, on a 0.1 mm thick NiCrAlY Bond Coat on 410 SS

- Specific Interfacial Thermal Resistance  $4.1 \text{ E-4 m}^2 \cdot \text{K/W}$

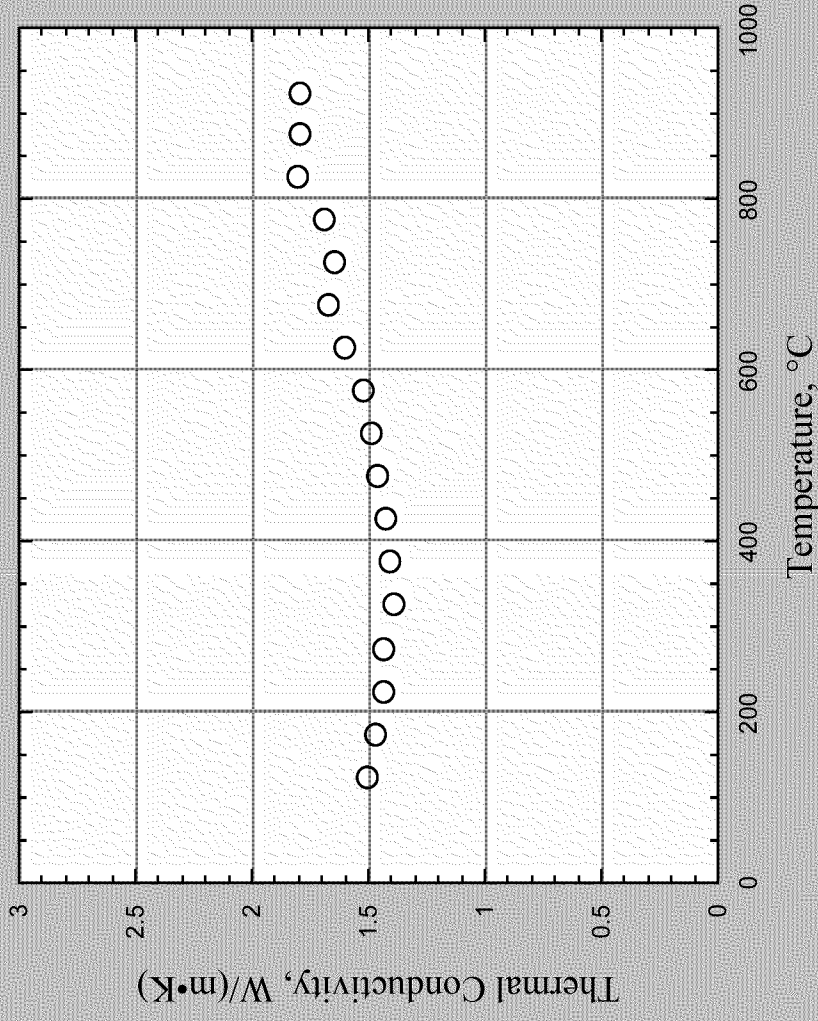


# Microstructure of a 7% YSZ EBPVD Coating



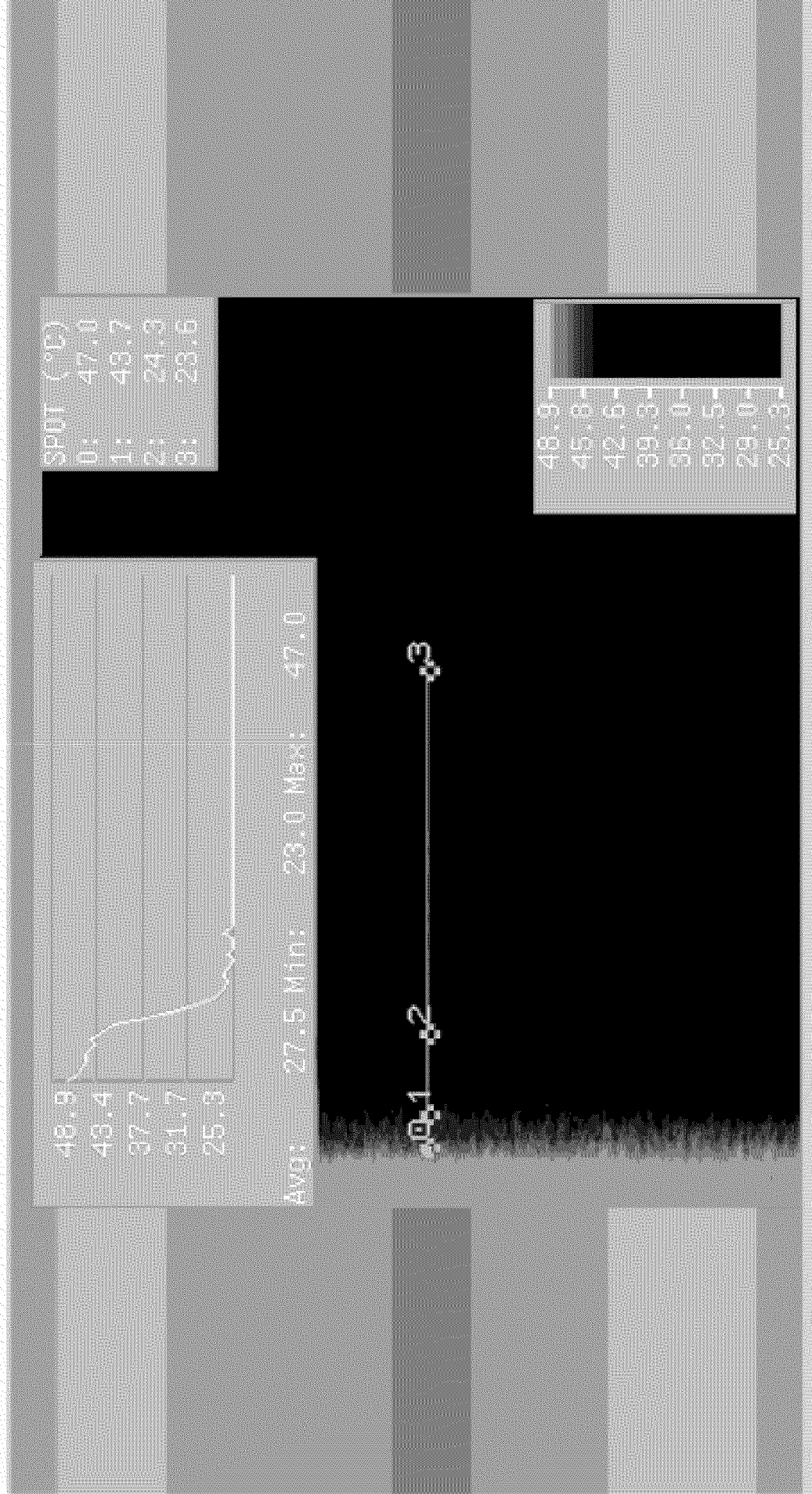


# GHP Measurement of an EBPVD Coating from an Industrial Collaborator





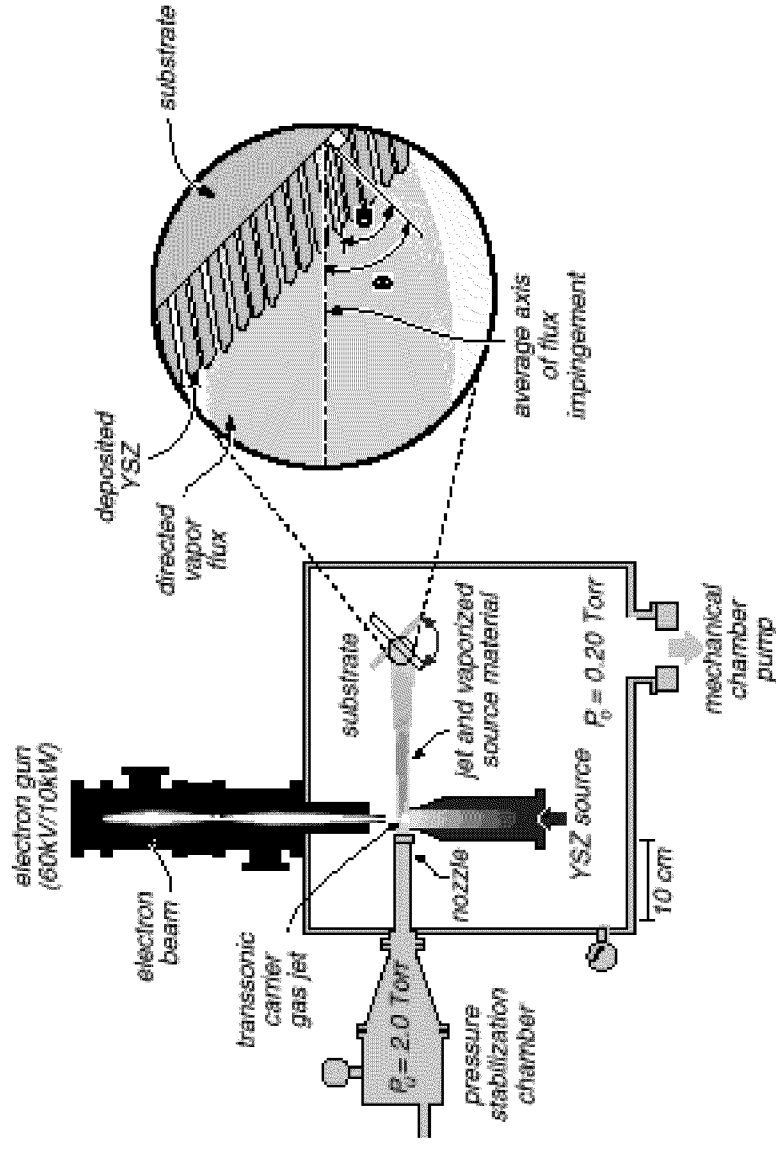
# Infrared Image of an EBPVD Coating



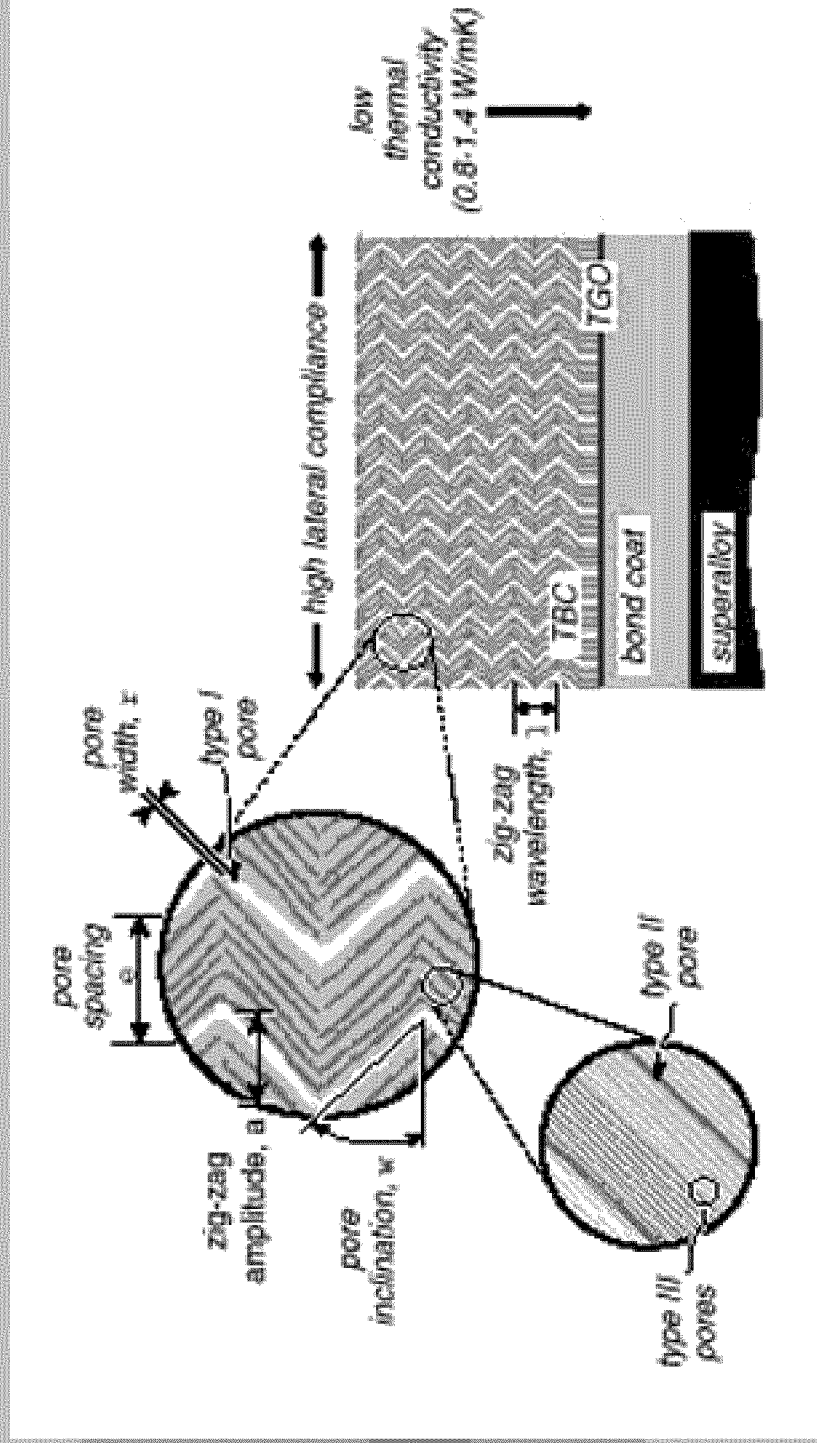
# IR Microscopy of Coatings

## EB-DVD method

*EB-DVD Processing Approach*

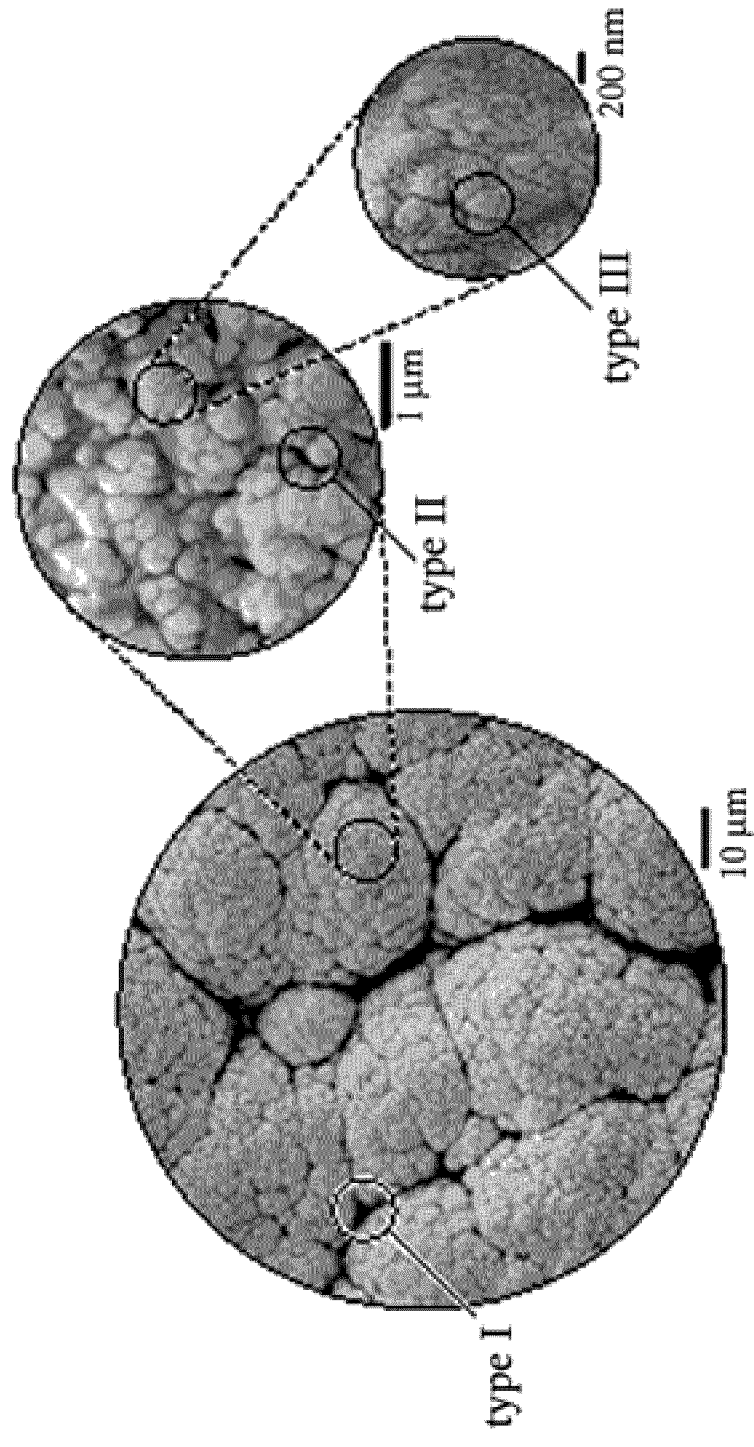


# Zig-Zag Coatings

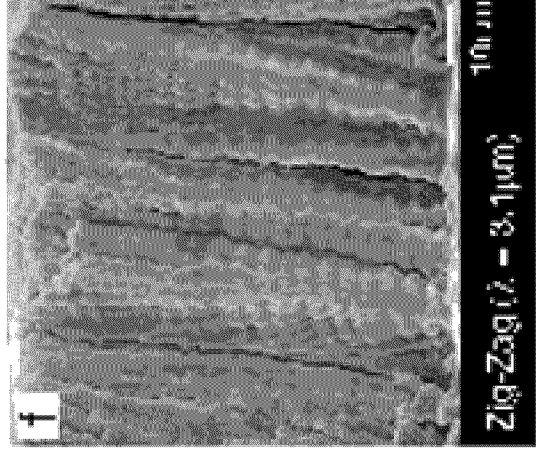
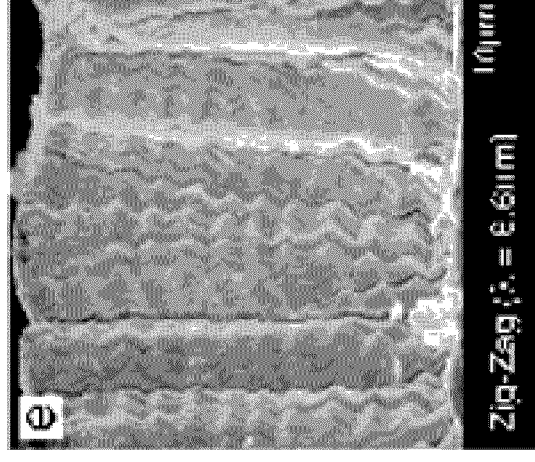
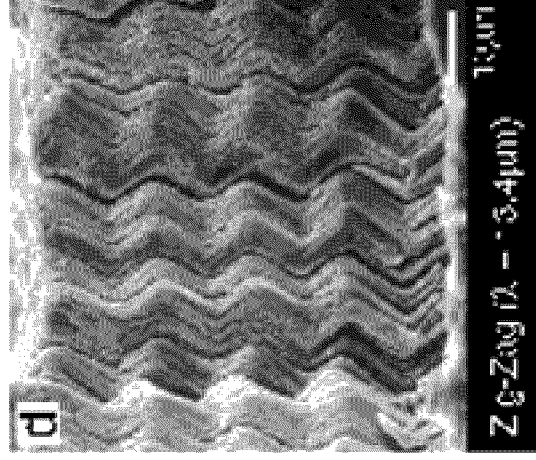
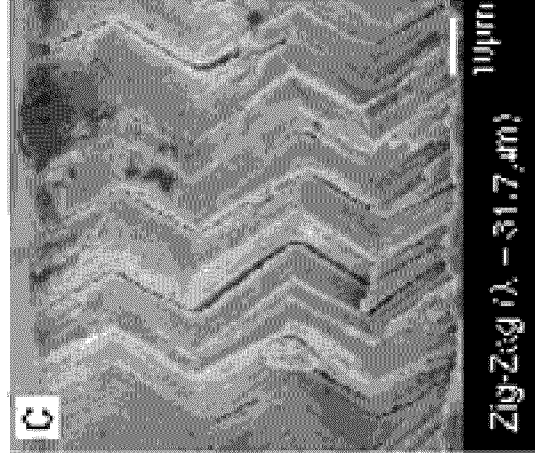
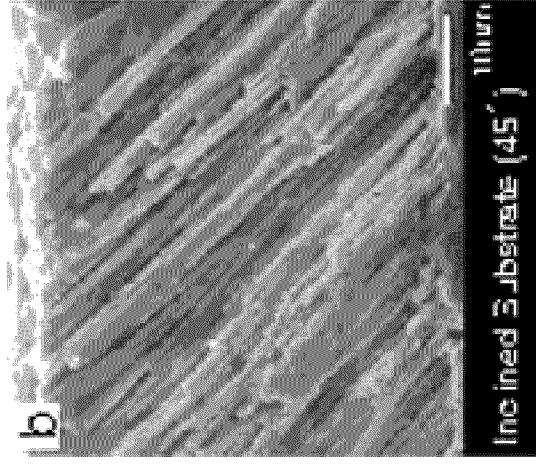
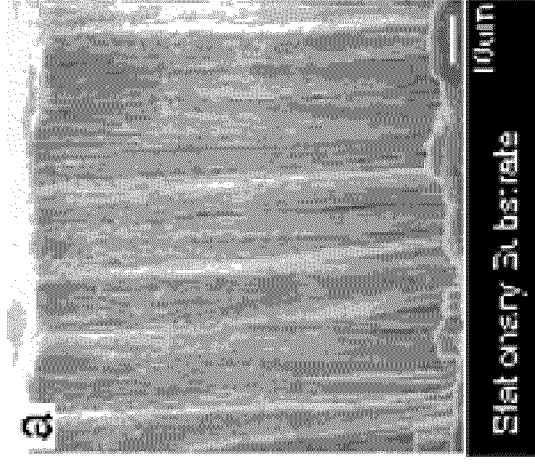




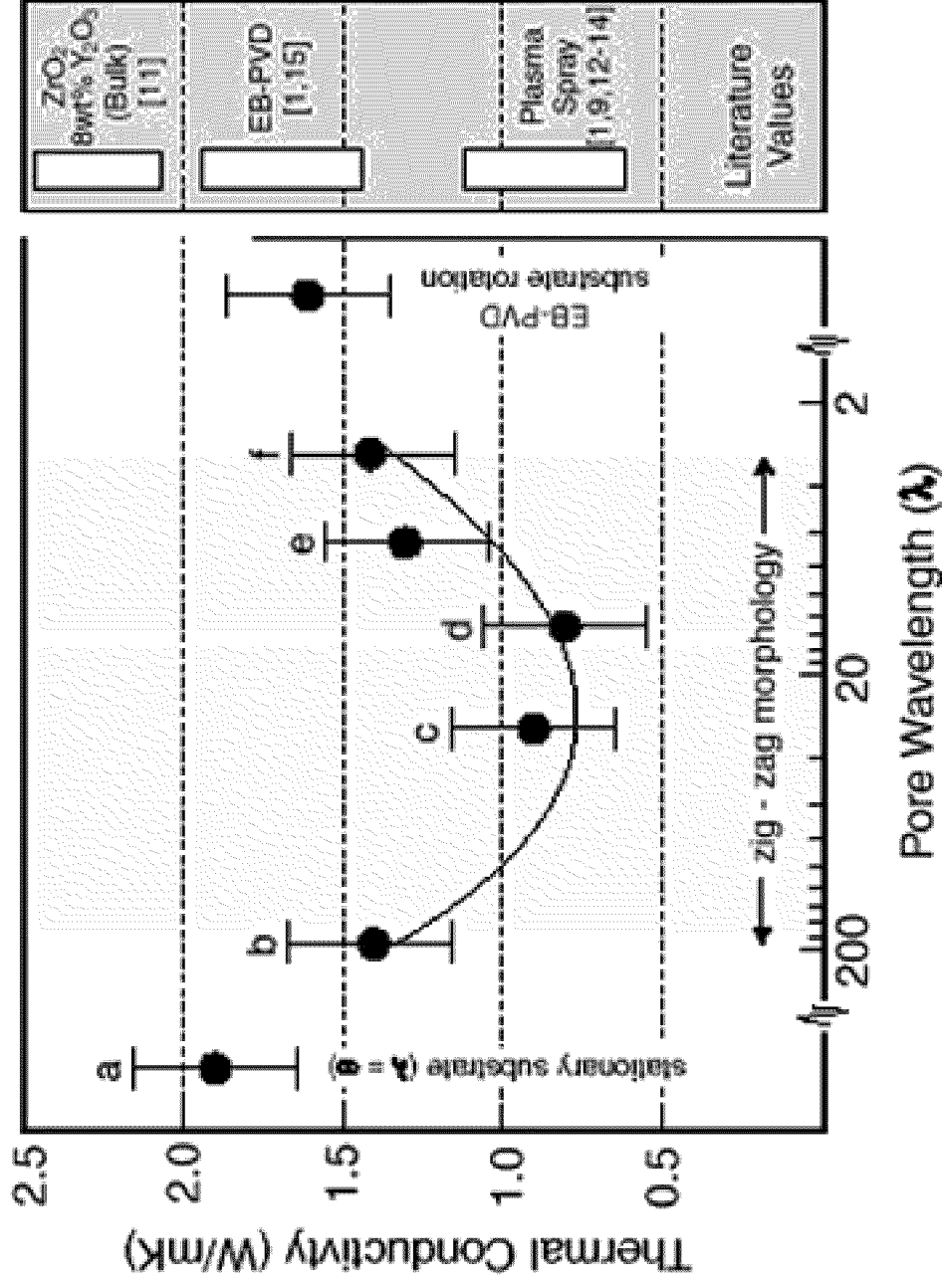
# Pore Morphology



# EB-DVD Coating Morphologies

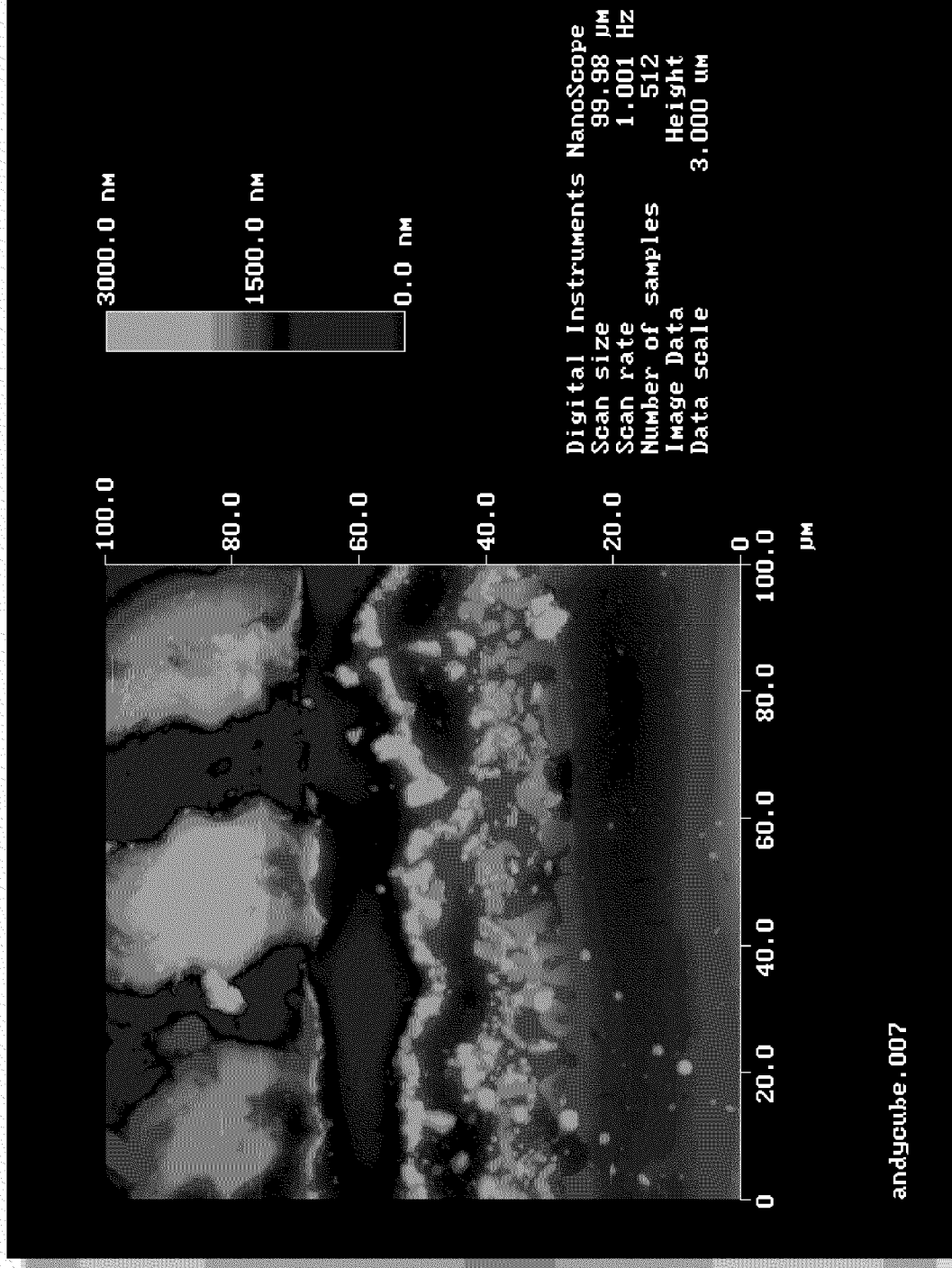


# Coating Thermal Conductivity

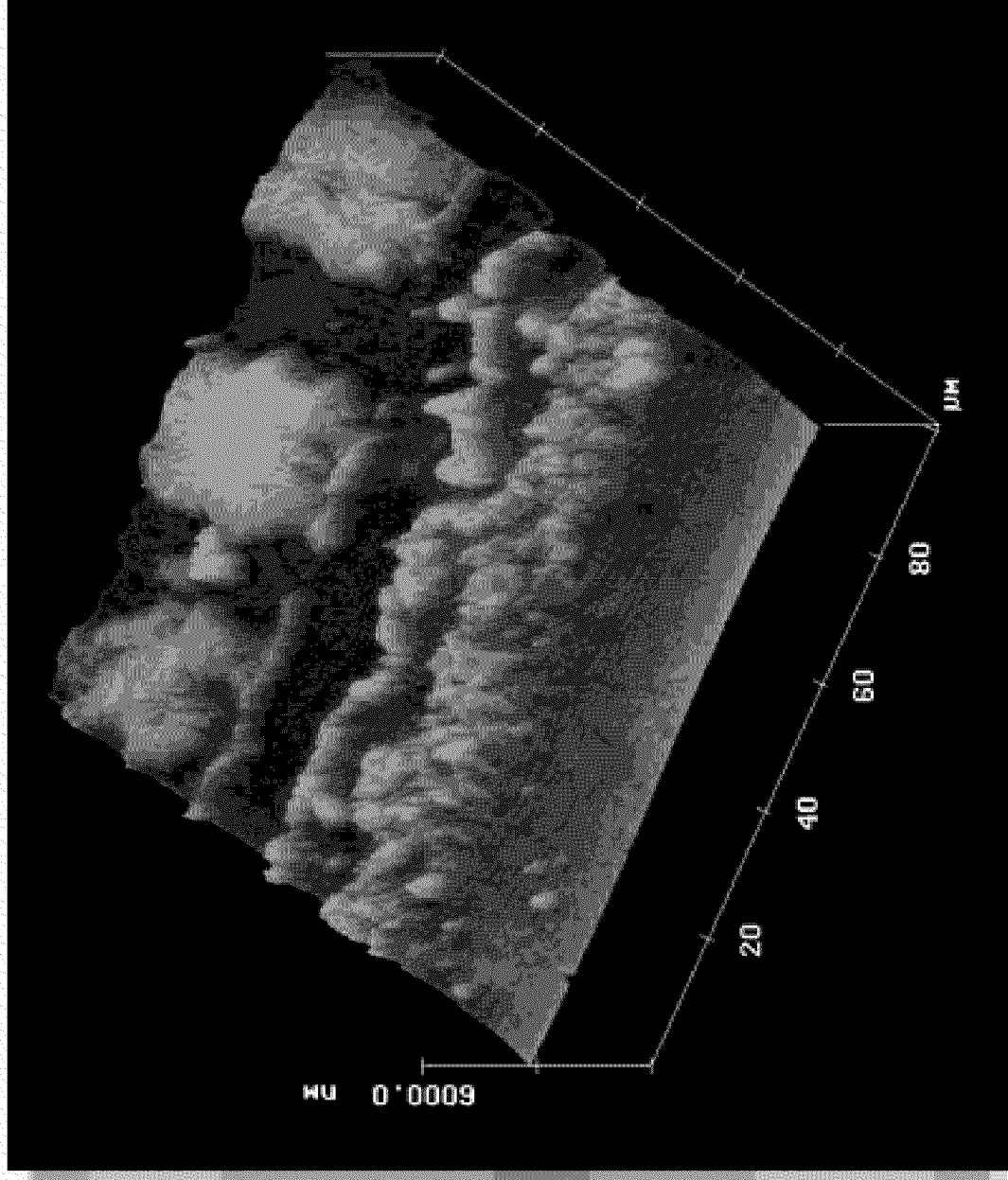




# Scanned-probe microscopy

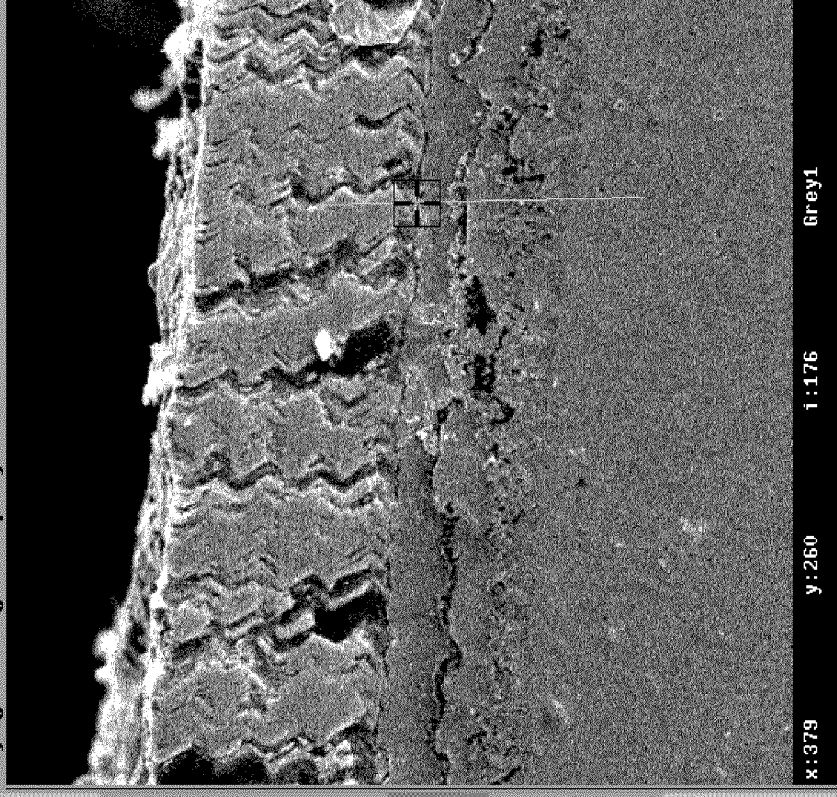


# Polishing is an Issue

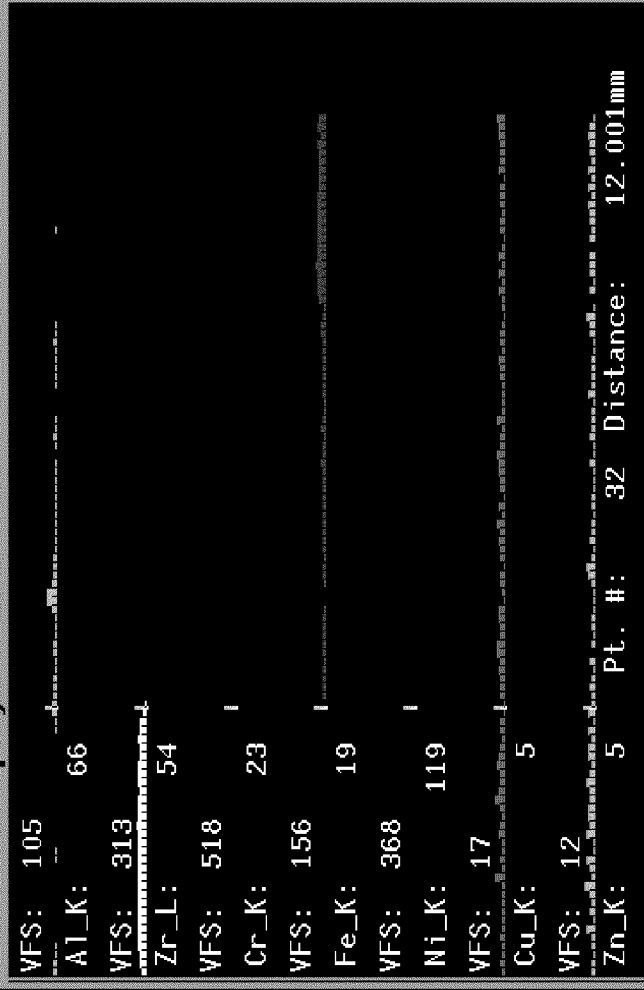


# Analysis of the Layers

Voyager Image Display

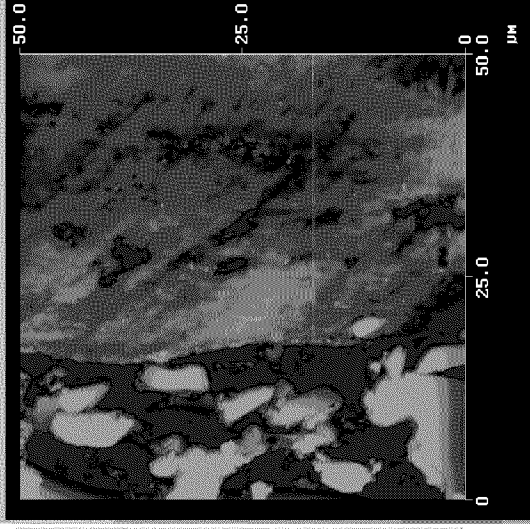
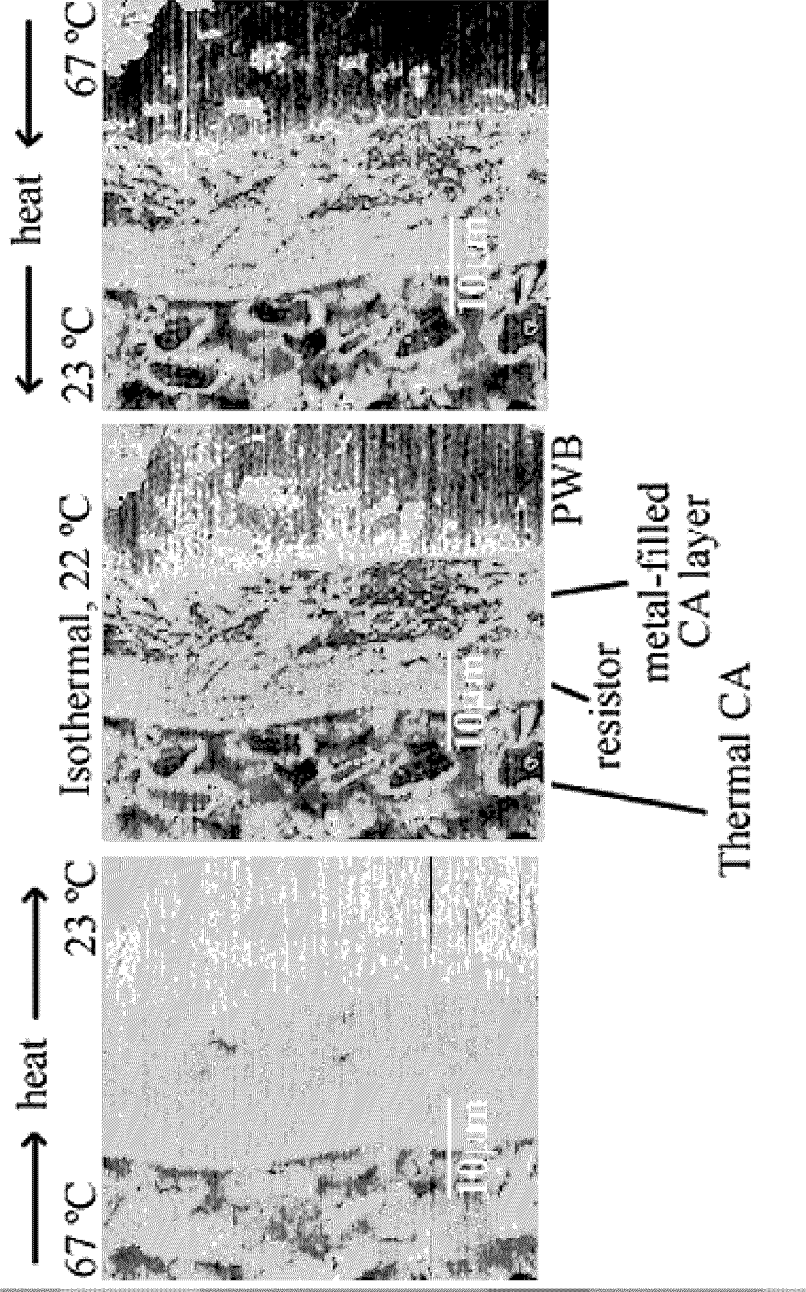


Linescan Display





# Thermal SPM



Topographic  
AFM